BTM420/421 DATA MODULE

Hardware Integration Guide
Version 3.2

global solutions: local support™

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REVISION HISTORY

Revision	Date	Description
1.0	22 June 2010	Initial Release
2.0	28 May 2012	Changes and Revisions
3.0	04 Jan 2013	Formatting, New Hardware Diagrams, FCC Statement updates
3.1	16 Jan 2014	Changed document name from User Manual to Hardware Integration Guide
3.2	05 Feb 2014	Added the Bluetooth SIG Approvals section

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OVERVIEW AND KEY FEATURES

The BTM420 and BTM421 Bluetooth modules from Laird Technologies have been designed to meet the needs of developers who wish to add robust, short range Bluetooth data connectivity to their products and who are using embedded Bluetooth stacks within their products. They are based on the market leading Cambridge Silicon Radio BC04 chipset, providing exceptionally low power consumption with outstanding range. They support the latest Bluetooth Version 2.1 Specification with EDR (Enhanced Data Rate). As well as increasing data throughput up to 2.1 Mbps, this provides the important advantage of Secure Simple Pairing, which improves security and enhances the ease of use for end customers.

With physical sizes as small as 12.5mm x 18.0mm and best of class, low power performance, these modules are the ideal choice for applications where designers need both performance and minimum size. For maximum flexibility in systems integration, the modules are designed to support separate power supplies for I/O and the USB interface.

These modules present an HCI interface through a USB interface and are fully qualified as Bluetooth Controller Subsystem Products. This allows designers to integrate them existing pre-approved Bluetooth Host and Profile subsystem stacks to gain a Bluetooth END product approval for their product.

A low cost developer's kit is available for prototyping. This ensures that the choice of Laird Technologies Bluetooth modules guarantees the fastest route to market.

Features and Benefits

- Bluetooth v2.1+EDR
- Adaptive Frequency Hopping to cope with interference from other wireless devices
- Support for Secure Simple Pairing
- External or internal antenna options
- HCI Interface over USB
- Bluetooth controller subsystem product qualified
- Compact size
- Class 2 output – 4dBm
- Low power operation
- USB interface
- Multipoint Support
- PCM & SCO for external codec
- Wi-Fi coexistence hardware support

Application Areas

- Embedded devices
- Phone accessories
- Security devices
- Medical and wellness devices
- Automotive applications
- Bluetooth® advertising
- ePOS

SPECIFICATIONS

Detailed Specifications

Table 1: Detailed Specifications

Categories	Feature	Implementation
Wireless Specification	Bluetooth®	Version 2.1+EDR
	Transmit Class	Class 2
	Frequency	2.402 – 2.480 GHz
	Channels	79 channels Frequency Hopping Adaptive Frequency Hopping
	Max Transmit Power	+4 dBm at antenna pad – BTM420 +4 dBmi (TBC) from integrated antenna – BTM421
	Receive Sensitivity	-84dBm
	Range	30m
	Data Transfer Rate	Up to 2.1 Mbps
Antenna Modes	External Antenna	50 Ohm matched SMT pad – BTM420
	Integrated Antenna (option)	+0 dB multiplayer ceramic (TBC) – BTM421
USB Interface	Compliance	Version 1.1
	Support	Version 2.0
	Supply Voltage	3.1 V to 3.3 V
General Purpose Interface	I/O	2 general purpose I.O pins for LEDs
Audio	Support	3 PCM Channels @ 64kbps
	SCO Channels	Support SCO and eSCO
	PCM Interface	Configurable as master or slave 8 bit A-law 8 bit μ-law 13 bit linear PCM Clock available when in slave mode
Protocols and Firmware	Bluetooth Stack	V2.1 compliant
	Connection Modes	Point to point (cable replacement) Multipoint – max 7 slaves

Table 2: Detailed Specifications

Categories	Feature	Implementation
Current Consumption	Data Transfer	Typically 32 mA
	Low Power Sniff Mode	Less than 2.5 mA
Supply Voltage	Supply	3.0 V – 3.3 V DC
Coexistence / Compatibility	WLAN (802.11)	2-wire and 3-wire hardware coexistence schemes supported
Connections	Interface	Surface Mount Pads

Categories	Feature	Implementation
	External Antenna	Pad for 50 Ohm antenna – BTM420
Physical	Dimensions	12.5 mm x 18.0 mm x 3.4 mm – BTM420 12.5 mm x 24.0 mm x 3.4 mm – BTM421
	Weight	3 grams
Environmental	Operating Temperature	-30°C to +70°C
	Storage Temperature	-40°C to +85°C
Approvals	Bluetooth	Qualified as a Controller Subsystem Product
	FCC	Limited Modular Approval – BTM420 Modular approval (Integrated Antenna option – BTM 421)
	CE & R&TTE	Meets CE and R&TTE requirements
Miscellaneous	Lead free	Lead-free and RoHS compliant
	Warranty	12 Months
Development Tools	Development Kit	Development board

Pin Definitions

Table 3: Pin Definitions

Pin	Signal	Description	Voltage Specification
1	Unused		
2	GND		
3	Unused		
4	Unused		
5	Unused		
6	Unused		
7	GND		
8	SPI_CSB	SPI bus chip select I/P	VIO
9	SPI_MISO	SPI bus serial O/P	VIO
10	SPI_MOSI	SPI bus serial I/P	VIO
11	SPI_CLK	SPI bus clock I/P	VIO
12	VDD_USB	USB & UART supply voltage	
15	GND		
16	PCM_IN	PCM clock I/P	VIO
17	PCM_SYNC	PCM sync I/P	VIO
18	PCM_CLK	PCM click I/P	VIO
19	PCM_OUT	PCM Data O/P	VIO
20	RESET	Module reset I/P	See note 2
21	Unused		
22	GPIO2 / UART_DCD	I/O for host	VIO
23	GND		
24	Unused		

Pin	Signal	Description	Voltage Specification
25	Unused		See note 3
26	Unused		See note 3
27	Unused		See note 3
28	GND		See note 3
29	ANT (BTM420)	Antenna connection (50 ohm matched)	See note 3
30	GND		See note 3
31	Unused		See note 3
32	Unused		See note 3
33	Unused		See note 3
34	Unused		See note 3
35	Unused		See note 3
36	Unused		See note 3
37	Unused		See note 3
38	Unused		
39	Unused		
40	Unused		
41	GNd		
42	GPIO1 / UART_RI	I/O for hose	VIO
43	Unused		
44	Unused		
45	GND		
46	D-	USB D-	VUSB
47	D+	USB D+	VUSB
48	Unused		
49	Unused		
50	Unused		

1. Unused pins may have internal connections and must not be connected.
2. Reset input is active low. Input is pulled up to VDD_IN via 22k. Minimum reset pulse width is 5 ms.
3. Pins 25-37 should be left not connected on modules with integrated antennae (BTM411, BTM421 and BTM431)

Operating Parameters

Table 4: Recommended Operating Conditions

Recommended Operating Conditions		
OPERATING CONDITION	MIN	MAX
VDD_USB (USB compatibility not required)	1.7	3.6
VDD_USB (USB compatibility required)	3.1	3.6
VDD_IO	1.7	3.3
VDD_IN	3.0	3.3

Voltage Specifications

Table 5: Logic Levels (VUSB)

Logic Levels (VUSB)			
INPUT VOLTAGE LEVELS	MIN	TYP	MAX
V_{ih}	0.7VDD_USB		
V_{il} 2.7 <VDD_USB<3.0	-0.4		+0.8
1.7<VDD_USB<1.9	-0.4		+0.4
Output Voltage Levels (1.7 <VDD_USB_1.9)			
V_{oh} (Iout = -4mA)	VDD_USB – 0.4		
V_{ol} (Iout = 4mA)			
Output Voltage Levels (2.7<VDD_USB<3.0)			
V_{oh} (Iout = -4mA)	VDD_USB – 2.0		
V_{ol} (Iout = 4mA)			0.2

Note: VDD_USB must be connected to power the USB and UART interfaces.

Table 6: Logic Levels (VIO)

Logic Levels (VIO)			
INPUT VOLTAGE LEVELS	MIN	TYP	MAX
V_{ih}	0.7VDD_IO		
V_{il} 2.7 <VDD_IO<3.0	-0.4		+0.8
1.7<VDD_IO<1.9	-0.4		+0.4
Output Voltage Levels (1.7 < VDD_IO < 1.9)			
V_{oh} (Iout = -4mA)	VDD_IO – 0.4		
V_{ol} (Iout = 4mA)			0.4
Output Voltage Levels (2.7 < VDd_IO < 3.0)			
V_{oh} (Iout = -4mA)	VDD_IO – 0.2		
V_{ol} (Iout = 4mA)			0.2

FCC REGULATORY STATEMENTS

BTM420 FCC and Industry Canada Statements

The Final Equipment user manual must show the following statements:

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

To comply with the FCC RF exposure compliance requirements, this device and its antenna must not be co-located or operating to conjunction with any other antenna or transmitter.

Considerations for OEM integration:

This module has a limited modular approval. Approval with any other antenna configuration or layout other than that approved will necessitate additional radiated emission testing to be performed.

To inherit the modular approval, the antennas for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

This module was approved with the following antenna:

- RF Solutions: ANT-24G-WHJ-SMA 0 dBi

Operation of this module with any other antenna will require additional testing to be performed.

Co-location with other radio transmitting devices operating concurrently in the same band will require additional testing and certification.

Designers should note the distinction that the FCC makes regarding portable and mobile devices. Mobile devices are defined as products that are not used closer than 20 cm to the human body, whereas portable devices can be used closer than 20 cm to the body. A device may be used in portable exposure conditions with no restrictions on host platforms when the averaged output power is less than the low power threshold for an uncontrolled environment ≤ 60/f(GHz) i.e. 25 mW for a 2.4 Ghz device. The Maximum Power Exposure for the BTM420 has been evaluated and found to comply with the low power threshold for an uncontrolled environment.

Refer to FCC document KDB 447498 for more information on RF exposure procedures and equipment authorization policies for mobile and portable devices.

FCC Labelling requirement

If the FCC ID is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. This exterior label can use wording such as the following: "Contains Transmitter Module FCC ID: PI4420B" or "Contains FCC ID: PI4420B." Any similar wording that expresses the same meaning may be used.

BTM421 FCC and Industry Canada Statements

The user manual must show the following statements:

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

To comply with the FCC RF exposure compliance requirements, this device and its antenna must not be co-located or operating to conjunction with any other antenna or transmitter.

Considerations for OEM integration:

To inherit the modular approval, the antennas for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

Co-location with other radio transmitting devices operating concurrently in the same band will require additional testing and certification.

Designers should note the distinction that the FCC makes regarding portable and mobile devices. Mobile devices are defined as products that are not used closer than 20 cm to the human body, whereas portable devices can be used closer than 20 cm to the body. A device may be used in portable exposure conditions with no restrictions on host platforms when the averaged output power is less than the low power threshold for an uncontrolled environment ≤ 60/f(GHz) i.e. 25 mW for a 2.4 Ghz device. The Maximum Power Exposure for the BTM421 has been evaluated and found to comply with the low power threshold for an uncontrolled environment.

Refer to FCC document KDB 447498 for more information on RF exposure procedures and equipment authorization policies for mobile and portable devices.

FCC Labelling requirement

If the FCC ID is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. This exterior label can use wording such as the following: "Contains Transmitter Module FCC ID: PI4421B" or "Contains FCC ID: PI4421B." Any similar wording that expresses the same meaning may be used.

EU DECLARATION OF CONFORMITY – BTM420

Manufacturer:	Laird Technologies
Product:	BTM420
EU Directive:	RTTE 1995/5/EC
Conformity Assessment:	Annex IV

Reference standards used for presumption of conformity:

Article Number:	Requirement:	Reference standard(s):
3.1a	Health and Safety	EN 60950-1:2006
3.1b	Protection requirements with respect to electromagnetic compatibility	EN 301 489-1 V1.8.1 EN 301 489-17 V2.1.1 Emissions: EN55022:2006/A1:2000/A2:2006 (ClassB) Immunity: EN61000-4-2:1995/A1:1998/A2:2001 EN61000-4-3:2002/A1:2002
3.2	Means of the efficient use of the radio frequency spectrum	EN 300 328 V1.7.1 (2006-10)

Declaration:

We, Laird Technologies, declare under our sole responsibility that the essential radio test suites have been carried out and that the above product to which this declaration relates is in conformity with all the applicable essential requirements of Article 3 of the EU Directive 1995/5/EC, when used for its intended purpose.

Place of Issue:	Laird Technologies Saturn House, Mercury Park Wooburn Green HP100HH, United Kingdom tel: +44 (0)1628 858 940 fax: +44 (0)1628 528 382
Date of Issue:	October 2009
Name of Authorised Person:	Tim Wheatley, Director of Engineering
Signature:	

EU DECLARATION OF CONFORMITY – BTM421

Manufacturer:	Laird Technologies
Product:	BTM421
EU Directive:	RTTE 1995/5/EC
Conformity Assessment:	Annex IV

Reference standards used for presumption of conformity:

Article Number:	Requirement:	Reference standard(s):
3.1a	Health and Safety	EN 60950-1:2006
3.1b	Protection requirements with respect to electromagnetic compatibility	EN 301 489-1 V1.8.1 EN 301 489-17 V2.1.1 Emissions: EN55022:2006/A1:2000/A2:2006(ClassB) Immunity: EN61000-4-2:1995/A1:1998/A2:2001 EN61000-4-3:2002/A1:2002
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Name of Authorised Person:	Tim Wheatley, Director of Engineering
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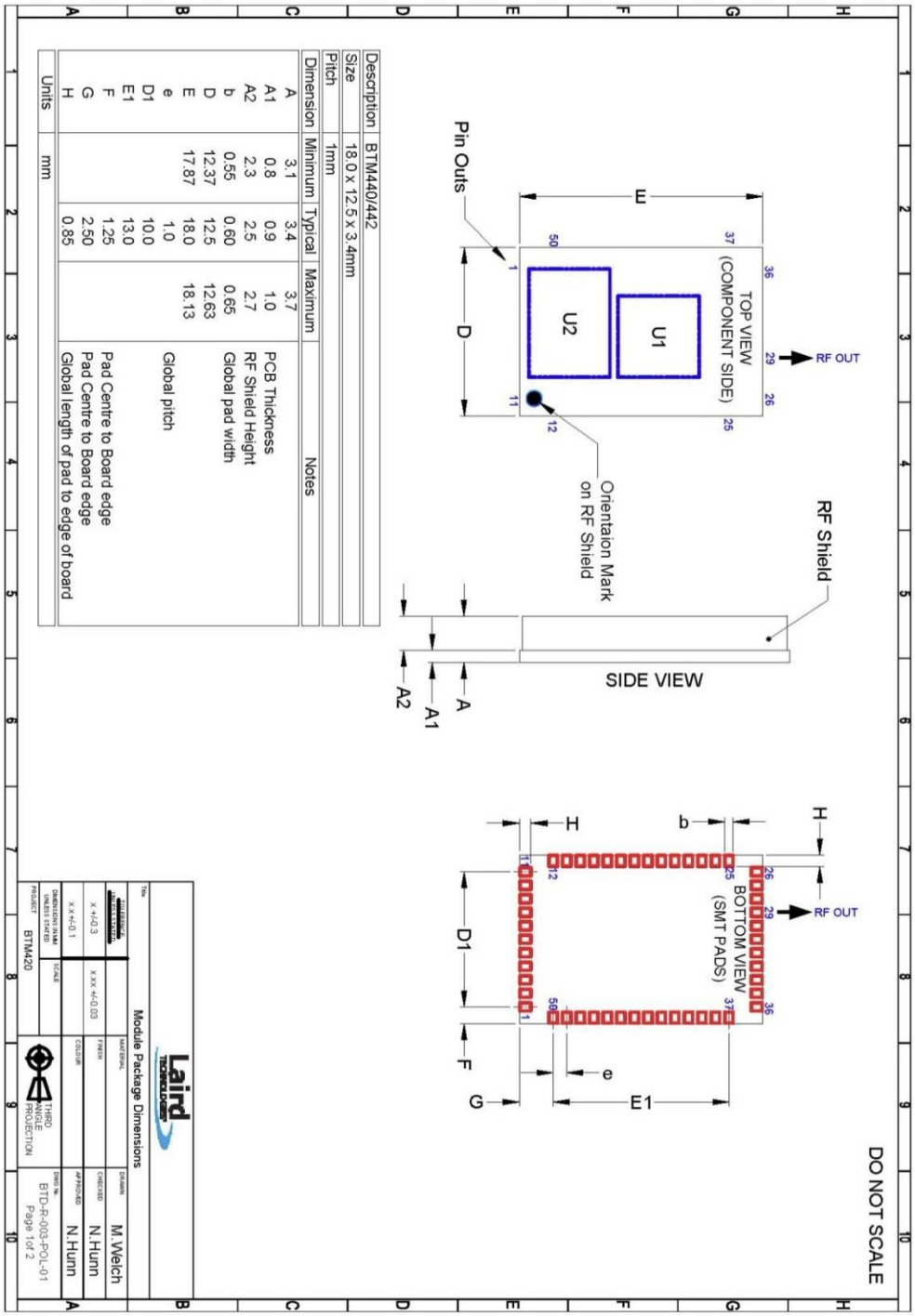
MECHANICAL DRAWINGS

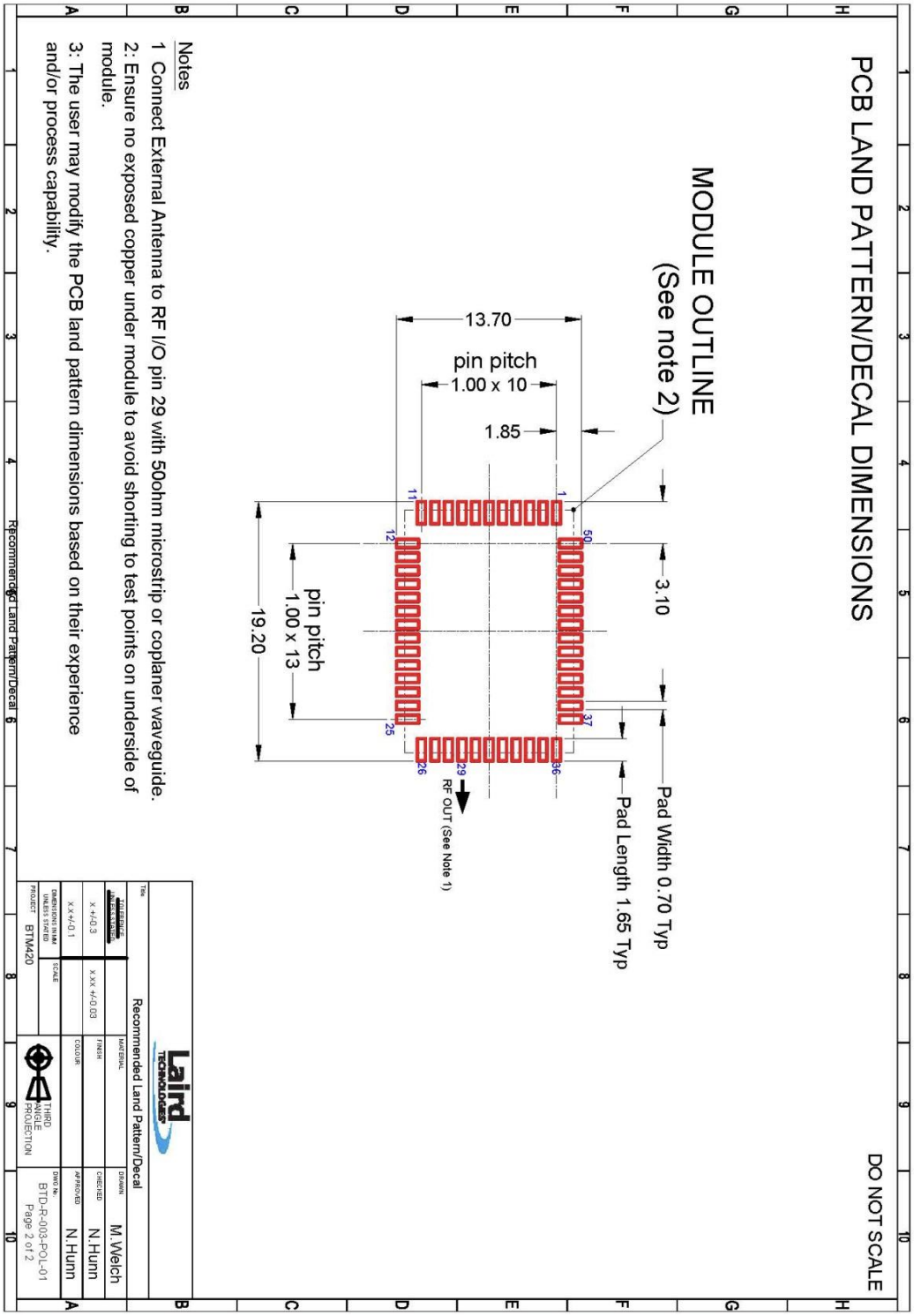
BTM420 Mechanical Details



Description	BTM440/442			
Size	18.0 x 12.5 x 3.4mm			
Pitch	1mm			
Dimension	Minimum	Typical	Maximum	Notes
A	3.1	3.4	3.7	
A1	0.8	0.9	1.0	PCB Thickness
A2	2.3	2.5	2.7	RF Shield Height
b	0.55	0.60	0.65	Global pad width
D	12.37	12.5	12.63	
E	17.87	18.0	18.13	
e		1.0		Global pitch
D1		10.0		
E1		13.0		
F		1.25		Pad Centre to Board edge
G		2.50		Pad Centre to Board edge
H		0.85		Global length of pad to edge of board
Units	mm			

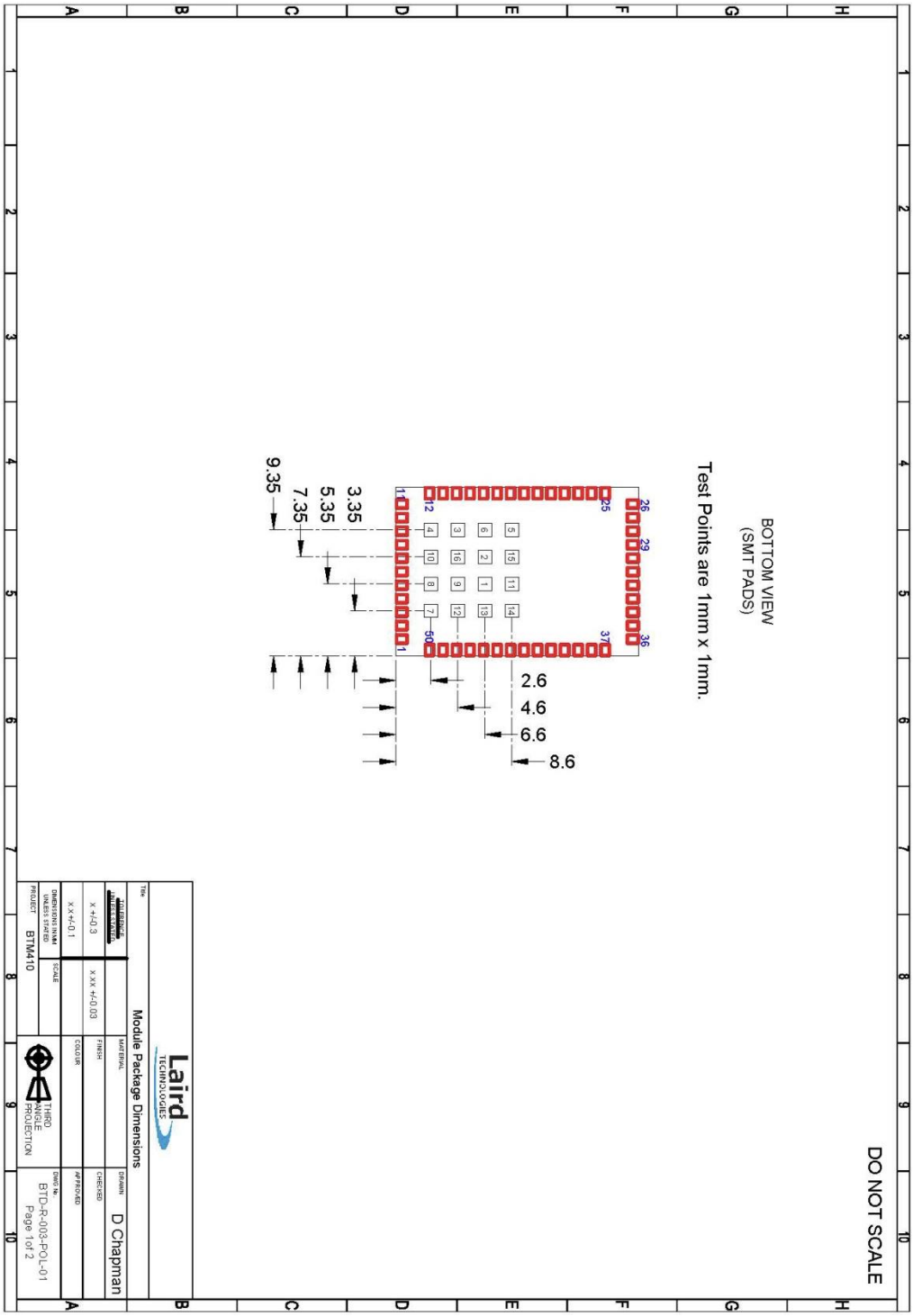
Note: An area of 1.5 mm around the module should be reserved as a keep-out area.

BTM420 Mechanical Details



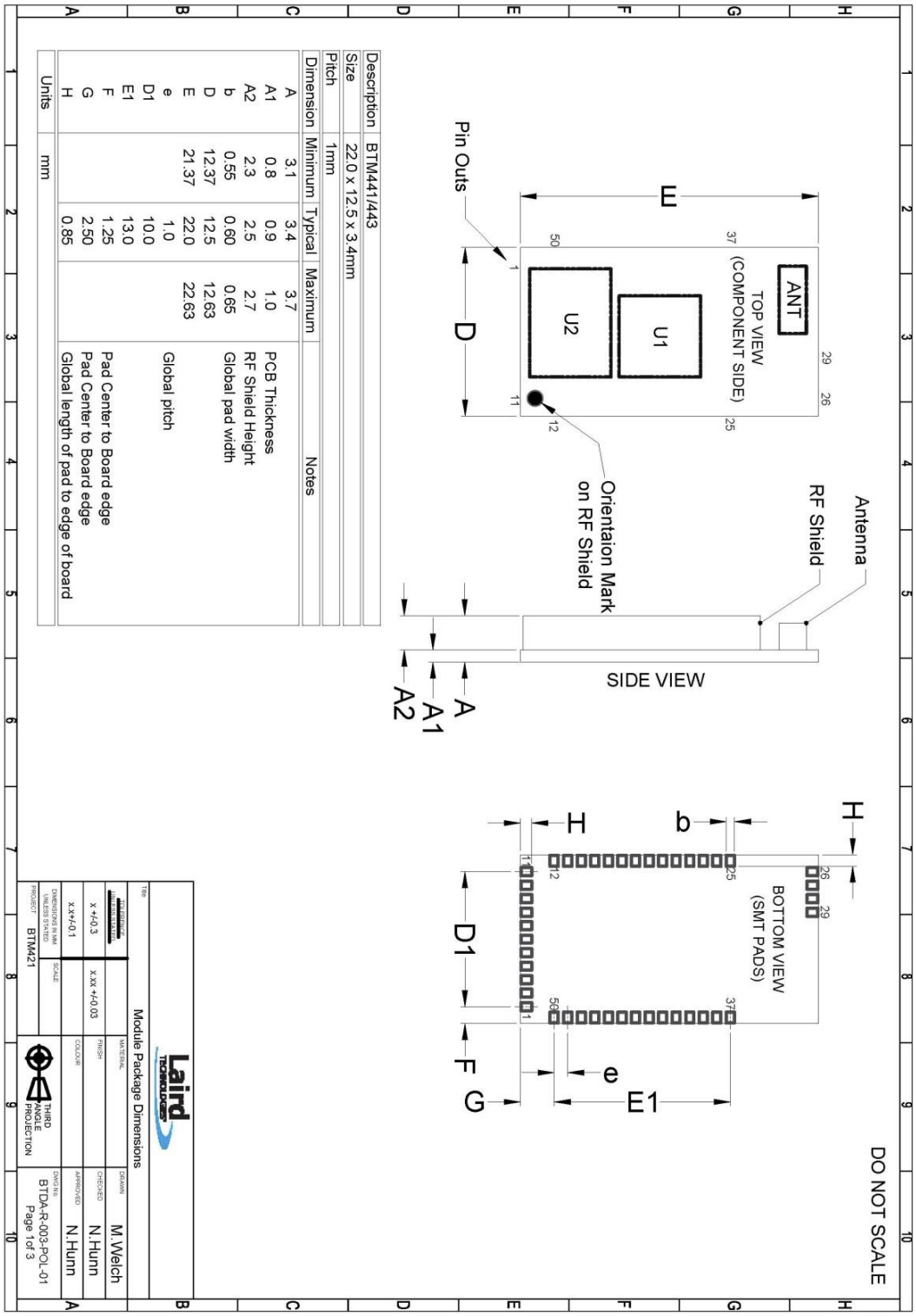
Note: An area of 1.5 mm around the module should be reserved as a keep-out area.

BTM420 Mechanical Details



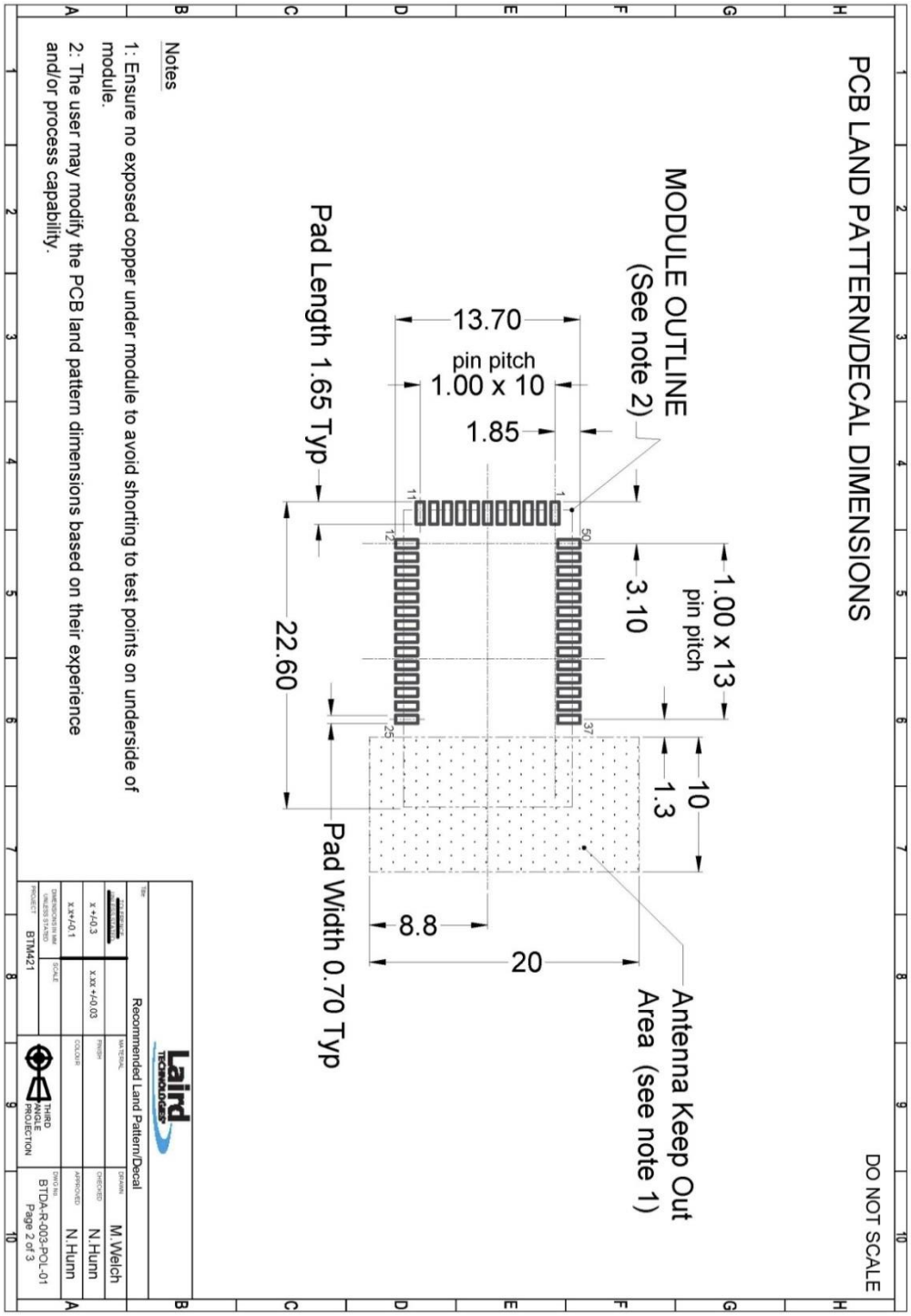
WARNING: Test point dimensions are for reference only. *DO NOT* make electrical connections to these test points, this will void the warranty. Laird does not recommend routing on the top layer underneath the module.

BTM421 Mechanical Details



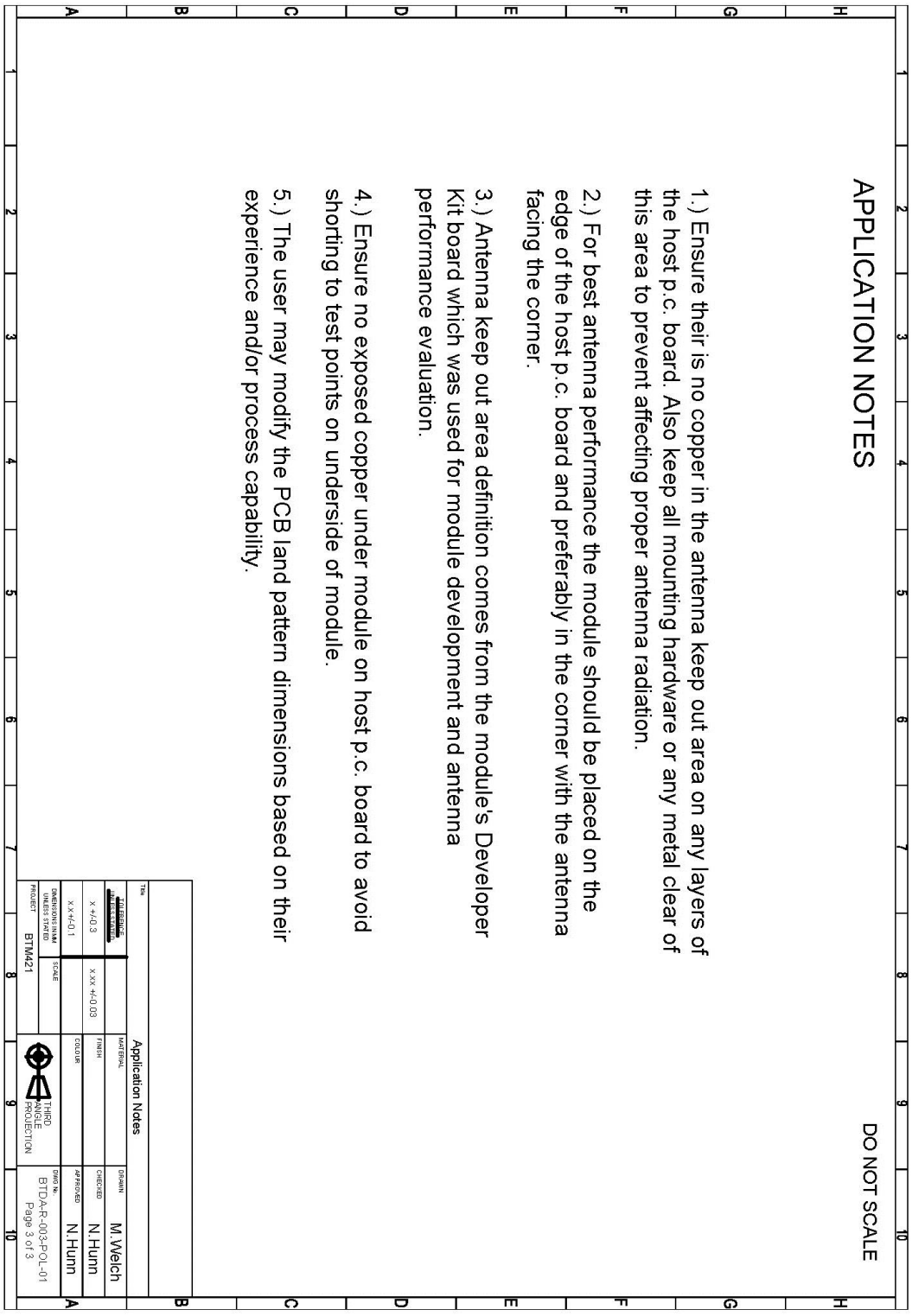
Note: An area of 1.5 mm around the module should be reserved as a keep-out area.

BTM421 Mechanical Details



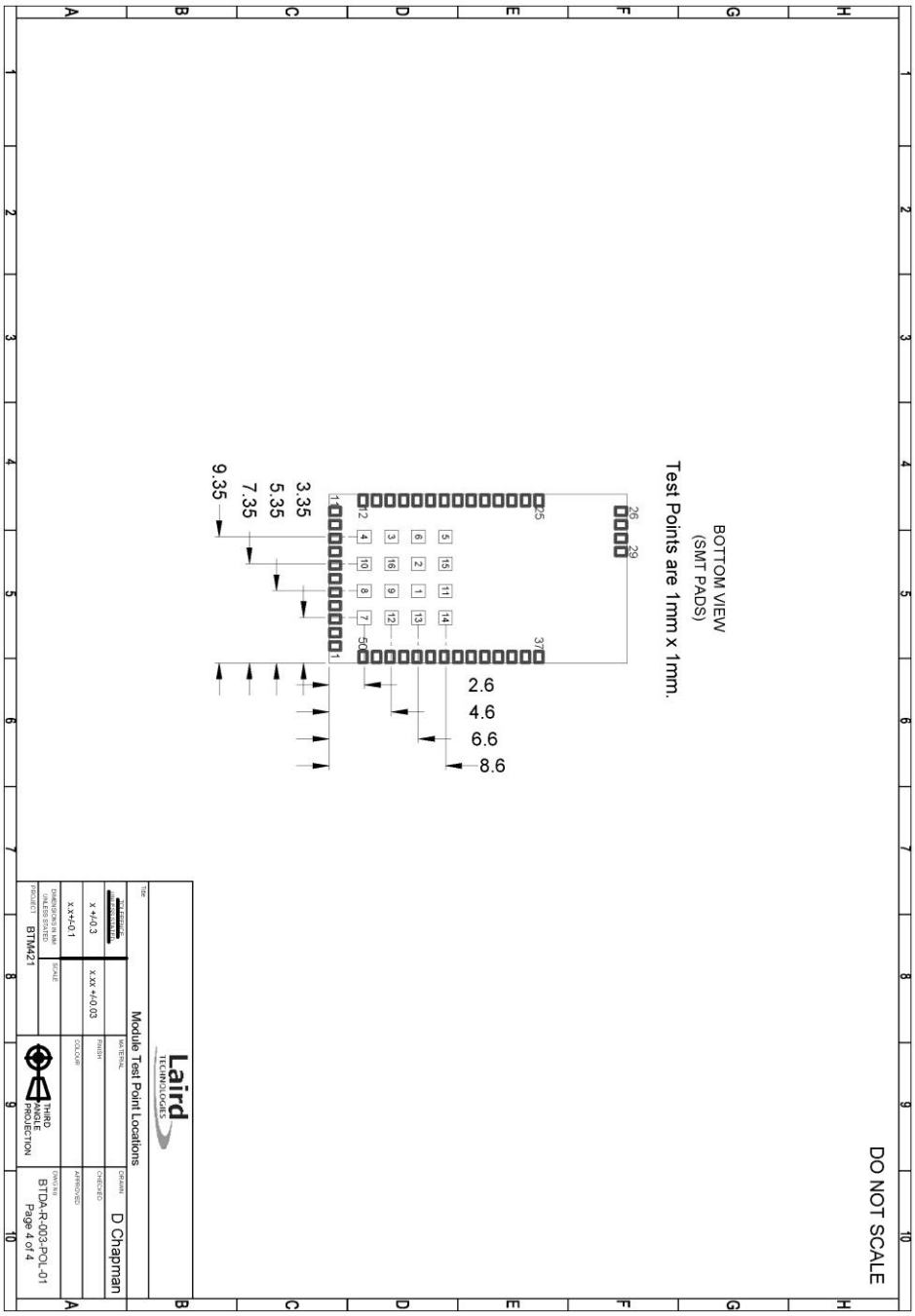
Note: An area of 1.5 mm around the module should be reserved as a keep-out area.

BTM421 Mechanical Details


APPLICATION NOTES
DO NOT SCALE
1.) Ensure their is no copper in the antenna keep out area on any layers of the host p.c. board. Also keep all mounting hardware or any metal clear of this area to prevent affecting proper antenna radiation.
2.) For best antenna performance the module should be placed on the edge of the host p.c. board and preferably in the corner with the antenna facing the corner.
3.) Antenna keep out area definition comes from the module's Developer Kit board which was used for module development and antenna performance evaluation.
4.) Ensure no exposed copper under module on host p.c. board to avoid shorting to test points on underside of module.
5.) The user may modify the PCB land pattern dimensions based on their experience and/or process capability.
Application Notes
M.Welch
N.Hunn
N.Hunn
BTM421
BTDA-R-003-POL-01
Page 3 of 3

Note: An area of 1.5 mm around the module should be reserved as a keep-out area.

BTM421 Mechanical Details



WARNING: Test point dimensions are for reference only. *DO NOT* make electrical connections to these test points, this will void the warranty. Laird does not recommend routing on the top layer underneath the module.

The Development Kit Schematics for this product can be accessed from the following link:
[Development Kit Schematics – BTM420 / BTM421]

BLUETOOTH SIG APPROVALS

Application Note: Subsystem Combinations

This application note covers the procedure for generating a new Declaration ID for a Subsystem combination on the Bluetooth SIG website. In the instance of subsystems, a member can combine two or more subsystems to create a complete Bluetooth End Product solution.

Subsystem listings referenced as an example:

Design Name	Owner	Declaration ID	Link to listing on the SIG website
BT800	Laird	B016072	https://www.bluetooth.org/tpg/QLI_viewQDL.cfm?qid=16072
Windows 8 (Host Subsystem)	Microsoft Corporation	B012854	https://www.bluetooth.org/tpg/QLI_viewQDL.cfm?qid=12854

Laird Customer Declaration ID Procedure

This procedure assumes that the member is simply combining two subsystems to create a new design, without any modification to the existing, qualified subsystems. This is achieved by using the Listing interface on the Bluetooth SIG website. Figure 1 shows the basic subsystem combination of a controller and host subsystem. The Controller provides the RF/BB/LM and HCI layers, with the Host providing L2CAP, SDP, GAP, RFCOMM/SPP and any other specific protocols and profiles existing in the Host subsystem listing. The design may also include a Profile Subsystem.

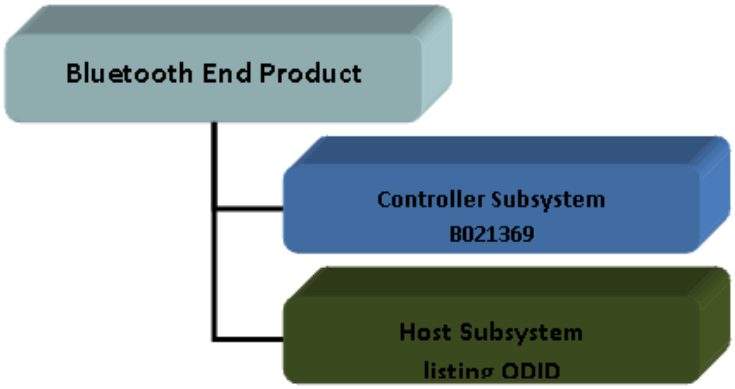


Figure 1: Basic subsystem combination of a controller and host subsystem

The Qualification Process requires each company to registered as a member of the Bluetooth SIG – http://www.bluetooth.org

The following link provides a link to the Bluetooth Registration page:
https://www.bluetooth.org/login/register/

For each Bluetooth Design it is necessary to purchase a Declaration ID. This can be done before starting the new qualification, either through invoicing or credit card payment. The fees for the Declaration ID will depend on your membership status, please refer to the following webpage:

https://www.bluetooth.org/en-us/test-qualification/qualification-overview/fees

For a detailed procedure of how to obtain a new Declaration ID for your design, please refer to the following SIG document:

https://www.bluetooth.org/DocMan/handlers/DownloadDoc.ashx?doc_id=283698&vId=317486

To start the listing, go to: https://www.bluetooth.org/tpg/QLI_SDoc.cfm.

In step 1, select the option, 'Reference a Qualified Design', and enter the Declaration IDs of each subsystem used in the End Product design. You can then select your pre-paid Declaration ID from the drop down menu or go to the Purchase Declaration ID page, (please note that unless the Declaration ID is pre-paid or purchased with a credit card, it will not be possible to proceed until the SIG invoice is paid.

Once all the relevant sections of step 1 are complete, complete steps 2, 3, and 4 as described in the help document. Your new Design will be listed on the SIG website and you can print your Certificate and DoC.

For further information please refer to the following training material:

https://www.bluetooth.org/en-us/test-qualification/qualification-overview/listing-process-updates

Additional Assistance

Please contact your local sales representative or our support team for further assistance:

Laird Technologies Connectivity Products Business Unit

Support Centre: http://ews-support.lairdtech.com

Email: wireless.support@lairdtech.com

Phone: Americas: +1-800-492-2320 Option 2
Europe: +44-1628-858-940
Hong Kong: +852 2923 0610

Web: http://www.lairdtech.com/bluetooth

ORDERING INFORMATION

Part Number	Description
BTM420	Bluetooth AT Data Module (external antenna)
BTM421	Bluetooth AT Data Module (with integrated antenna)
DVK – BTM420	Development board with BTM420 module soldered in place
DVK – BTM421	Development board with BTM421 module soldered in place

GENERAL COMMENTS

All information in this document is subject to change. Please check with Laird Technologies for the latest information before commencing a design. If in doubt, ask.

Refer to the schematic BTDMD-R-001.pdf for the Development Kit on the following two pages for examples of typical pin connections. A PDF of the schematic can be downloaded from the product web page.

Laird Technologies is the world leader in the design and manufacture of customized, performance-critical products for wireless and other advanced electronics applications. Laird Technologies partners with its customers to find solutions for applications in various industries such as:

- Network Equipment
- Telecommunications
- Data Communications
- Automotive Electronics
- Computers
- Aerospace
- Military
- Medical Equipment
- Consumer Electronics

Laird Technologies offers its customers unique product solutions, dedication to research and development, as well as a seamless network of manufacturing and customer support facilities across the globe.

global solutions: local support™

LWS-UM-BTM420-421_v3.0_0313

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